Corrosion Behaviour of the CoW\textsubscript{0.013}C\textsubscript{0.001} Alloy in Acidic Sulphate Aqueous Solutions containing Sodium Lauryl Sulphate and Sodium Citrate

Benedetto Bozzini\textsuperscript{1}, Gian Pietro De Gaudenzi\textsuperscript{2}, Claudio Mele\textsuperscript{1}

\textsuperscript{1}INFM - Dipartimento di Ingegneria dell’Innovazione - Università di Lecce, v. Monteroni, 73100 Lecce, Italy
\textsuperscript{2} Films S.p.a., v. Megolo 2, I-28877 Anzola d’Ossola (VB) - Italy

The corrosion behaviour of the Co\textsubscript{W\textsubscript{0.013}}C\textsubscript{0.001} binder alloy has been shown to be the key factor in the chemical stability of WC-Co type hardmetals. The anodic oxidation of the CoW\textsubscript{0.013}C\textsubscript{0.001} alloy was studied in 0.1M H\textsubscript{2}SO\textsubscript{4} containing 20 mM sodium lauryl sulphate and 20 mM tri-sodium-citrate. In this investigation we used linear sweep voltammetry, chronoamperometry and AC impedance measurements. Electrochemical impedance transients convey additional information on anodic activation processes occurring during corrosion. The reaction products morphology and composition were studied by scanning electron microscopy and energy dispersive spectroscopy. The inhibiting effects of the organic additives on the pseudopassivating mechanisms were described. The precipitation of layers of corrosion products with different protective effectiveness was assessed and correlated to the electrochemical kinetics and to the morphological and chemical peculiarities brought about by the presence of the organics. Sodium citrate proves more effective that sodium lauryl sulphate in inhibiting corrosion in the test conditions relevant to this work.

The relevance of a detailed knowledge of the corrosion behaviour of WC-Co hardmetals to the development of the applications of these materials has been recently underscored [1-5]. The corrosion behaviour of this class of materials has been recognised to be ruled essentially by the galvanic coupling of the anodic binder to the cathodic ceramic [6, 7]. The corrosion activity of the binder plays a critical role whose knowledge ought to be furthered at this stage of the R&D of harnmetal-type materials. The corrosion behaviour of Co-W-C alloys simulating the binder phase resulting from the diffusion of W and C from WC into Co during the sintering process of green hardmetal, was studied quite extensively in [5-7]. The compositional and structural information on these alloys, relevant to the present investigation has been reviewed in [5]. The anodic behaviour of the binder phase has been shown to exhibit a pseudopassive behaviour due to the formation of a porous layer of corrosion products [5-7]. Since current densities of several tens of mA cm\textsuperscript{-2} are typically measured, this cannot result from diffusion or ionic mobility through a coherent film. A persisting contact between the metal surface and the electrolyte via pores or cracks has been hypothesised in [7]. This kind of behaviour is induced by the presence of the alloying elements. EDX, XRD, CV and EIS investigations have shown that the pseudopassivating layer develops out of the progressive surface enrichment with W [5]. The anodic behaviour of Co-W-C alloys has also been found to be related to the mechanical stability of the pseudopassivating layer.

The present investigation is based on linear sweep voltammetry (LSV), cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and it is complemented by compositional (energy dispersive spectroscopy EDX) and morphological (scanning electron microscopy SEM) analyses.